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# THE UNITED STATES OF AMERICA

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**APPLICATION NUMBER: 10/783,110**

**FILING DATE: February 19, 2004**

**By Authority of the  
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**W. MONTGOMERY**  
**Certifying Officer**

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**UTILITY  
PATENT APPLICATION  
TRANSMITTAL**

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.

First Inventor

Title

Express Mail Label No.

**APPLICATION ELEMENTS****ADDRESS TO:**Assistant Commissioner for Patents  
Box Patent Application  
Washington, DC 20231

See MPEP chapter 600 concerning utility patent application contents.

1. ☒ Fee Transmittal Form (e.g., PTO/SB/17)  
(Submit as original and a duplicate for fee processing)
2. ☒ Applicant claims small entity status.  
See 37 CFR 1.27.
3. ☒ Specification [Total Pages 9]  
(preferred arrangement set forth below)
- Descriptive title of the invention
  - Cross Reference to Related Applications
  - Statement Regarding Fed sponsored R & D
  - Reference to sequence listing, a table, or a computer program listing appendix
  - Background of the invention
  - Brief Summary of the invention
  - Brief Description of the Drawings (if filed)
  - Detailed Description
  - Claim(s)
  - Abstract of the Disclosure
4. ☒ Drawing(s) (35 U.S.C. 113) [Total Sheets 1]
5. Oath or Declaration [Total Pages     ]
- a. ☒ Newly executed (original or copy)  
Copy from a prior application (37 CFR 1.63 (d))  
(for continuation/divisional with Box 18 completed)
- b. ☐ **DELETION OF INVENTOR(S)**  
Signed statement attached deleting inventor(s)  
named in the prior application, see 37 CFR  
1.63(d)(2) and 1.53(b).
6. ☐ Application Data Sheet. See 37 CFR 1.76

7. ☐ CD-ROM or CD-R in duplicate, large table or Computer Program (Appendix)
8. Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary)
- a. ☐ Computer Readable Form (CRF)
- b. Specification Sequence Listing on:
- i. ☐ CD-ROM or CD-R (2 copies); or
- ii. ☐ paper
- c. ☐ Statements verifying identity of above copies

**ACCOMPANYING APPLICATION PARTS**

9. ☐ Assignment Papers (cover sheet & document(s))
10. ☐ 37 CFR 3.73(b) Statement (when there is an assignee) ☐ Power of Attorney
11. ☐ English Translation Document (if applicable)
12. ☐ Information Disclosure Statement (IDS)/PTO-1449 ☐ Copies of IDS Citations
13. ☐ Preliminary Amendment
14. ☐ Return Receipt Postcard (MPEP 503) (Should be specifically itemized)
15. ☐ Certified Copy of Priority Document(s) (if foreign priority is claimed)
16. ☐ Nonpublication Request under 35 U.S.C. 122 (b)(2)(B)(i). Applicant must attach form PTO/SB/35 or its equivalent.
17. ☐ Other: NUMBERED ELEMENTS

18. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in a preliminary amendment, or in an Application Data Sheet under 37 CFR 1.76:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP)

of prior application No. \_\_\_\_\_

Group Art Unit \_\_\_\_\_

Prior application information:

Examiner \_\_\_\_\_

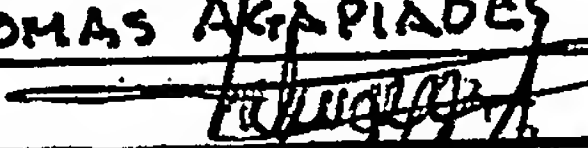
For CONTINUATION OR DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 5b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

**19. CORRESPONDENCE ADDRESS**☐ Customer Number or Bar Code Label

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or ☐ Correspondence address below

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Name (Print/Type)	THOMAS AGAPIADES	Registration No. (Attorney/Agent)	
Signature		Date	02-19-04

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22859 U.S. PTO  
10/783110

021904



# FEE TRANSMITTAL

## for FY 2002

Patent fees are subject to annual revision.

Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT

(\$)

Complete if Known

Application Number

Filing Date

First Named Inventor

THOMAS AGAPIADES

Examiner Name

Group Art Unit

Attorney Docket No.

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☐ Deposit Account

Deposit Account Number  
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☐ Charge fee(s) indicated below ☐ Credit any overpayments  
☐ Charge any additional fee(s) during the pendency of this application  
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### FEE CALCULATION

#### 1. BASIC FILING FEE

Large Entity Small Entity

Fee Code (\$)	Fee Code (\$)	Fee Description	Fee Paid
101 740	201 370	Utility filing fee	385
106 530	206 165	Design filing fee	
107 510	207 255	Plant filing fee	
108 740	208 370	Reissue filing fee	
114 160	214 60	Provisional filing fee	

SUBTOTAL (1) (\$)

#### 2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

Total Claims	Extra Claims	Fee from	Fee Paid
Independent Claims	-20** =	X	
Multiple Dependent	-3** =	X	

Large Entity Small Entity

Fee Code (\$)	Fee Code (\$)	Fee Description
103 18	203 9	Claims in excess of 20
102 64	202 42	Independent claims in excess of 3
104 280	204 140	Multiple dependent claim, if not paid
109 64	209 42	** Reissue independent claims over original patent
110 18	210 9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) (\$)

(5) 385

\*For number previously paid, if greater; For Reissue, see above.

### FEE CALCULATION (continued)

#### 3. ADDITIONAL FEES

Large Entity Small Entity

Fee Code (\$)	Fee Code (\$)	Fee Description	Fee Paid
105 130	205 65	Surcharge - late filing fee or oath	
127 50	227 25	Surcharge - late provisional filing fee or cover sheet	
139 130	139 130	Non-English specification	
147 2,520	147 2,520	For filing a request for ex parte reexamination	
112 920*	112 920*	Requesting publication of SIF prior to Examiner action	
113 1,840*	113 1,840*	Requesting publication of SIF after Examiner action	
115 110	215 55	Extension for reply within first month	
116 400	216 200	Extension for reply within second month	
117 920	217 460	Extension for reply within third month	
118 1,440	218 720	Extension for reply within fourth month	
128 1,980	228 980	Extension for reply within fifth month	
119 320	219 160	Notice of Appeal	
120 320	220 160	Filing a brief in support of an appeal	
121 260	221 140	Request for oral hearing	
136 1,510	136 1,510	Petition to institute a public use proceeding	
140 110	240 55	Petition to revive - unavoidable	
141 1,280	241 640	Petition to revive - unintentional	
142 1,280	242 640	Utility issue fee (or reissue)	
143 480	243 230	Design issue fee	
144 620	244 310	Plant issue fee	
122 130	122 130	Petitions to the Commissioner	
123 60	123 30	Processing fee under 37 CFR 1.17(q)	
125 180	125 180	Submission of Information Disclosure Stmt	
501 40	501 40	Recording each patent assignment per property (times number of properties)	
145 740	245 370	Filing a submission after final rejection (37 CFR § 1.129(a))	
146 740	246 370	For each additional invention to be examined (37 CFR § 1.129(b))	
179 740	279 370	Request for Continued Examination (RCE)	
189 900	189 900	Request for expedited examination of a design application	

Other fee (specify)

\*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) (\$)

### INVENTOR BY

Name (Print)

THOMAS AGAPIADES

Signature

*Thomas Agapiades*

Registration No.

Attorney/Agent

Complete if applicable

Telephone

530-218-4020

Date

02-19-04

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# TIMING GEAR FLEXIBLE COUPLING

## BACKGROUND OF THE INVENTION

The invention comprises an intervening resilient member that is mounted between the hub of an engine timing gear and timing shaft rotatively mounted in the cylinder head of a disc valve engine. The resilient member serves as a flexible coupling between the timing gear and the timing shaft. Flexible couplings are most generally used to provide shaft torque flexibility under heavy starting loads or to offset shaft misalignment. The resilient member in the present invention, while providing flexibility under torque loads is used in a unique manner that constitutes the novelty of this invention. The resilient member provides a means of lowering peak friction loads at the sliding interface between a stationary stator surface and the surface of a rotating disc valve operating within the fluctuating pressure field of an engine combustion chamber.

Rotation of the said disc valve mounted within the engine combustion chamber periodically opens and closes a plurality of exhaust and intake ports in the stationary stator of the engine cylinder head in a sequential manner corresponding to the alternating order of the engine thermodynamic pressure cycle. The flexible coupling between the said timing gear and said timing shaft momentarily slows the rotational velocity of the disc valve during the highest peak pressure of the engine combustion stroke at the point of the ignition spike thereby reducing the sliding contact frictional energy between the disc and stator surfaces which is exponentially at its highest point during this brief period.



1  
2 At the few milliseconds of peak combustion pressure ignition spike the  
3 resilient member between the hub of the said timing gear and said timing shaft  
4 is slightly compressed causing the said timing shaft to rotate slower than said  
5 timing gear for a brief instant over a small millisecond increment of rotation  
6 and thereby transmitting a slowing motion to the disc valve rotation. This  
7 slowing motion is hardly measurable, but at the molecular interface of the  
8 lubricating film between the surfaces in slidable contact the shearing impact  
9 across the said interface is lessened exponentially as a function of the  
10 contacting velocity. Absorption of peak torque loads on the timing shaft by  
11 the resilient member during the peak combustion pressures when the sliding  
12 contact friction between the disc valve and stator are highest will lessen wear  
13 between the two surfaces and lower the potential for galling.

14 The resilient member is an elastic material capable of fully responding  
15 over the engine operating frequency. Formulation of rubber resilient members  
16 with extenders or catalyst accelerators will stiffen the response in a manner  
17 that permits full recovery after each compression and will not couple with the  
18 engine's natural frequency. The resilient member may be manufactured from  
19 any material which has the physical properties of sustained response of rapid  
20 compression loads with rapid recovery and good storage durability and with  
21 long term fatigue capability under heavy load.

## 22 23 SUMMARY OF THE INVENTION

24 The invention is a flexible coupling comprising an intervening resilient  
25 member placed between the hub of a timing gear and the timing shaft of a  
26 rotary disc valve engine. At the peak of the combustion stroke, during the  
27  
28

1 ignition spike, the said resilient member is compressed to its fullest extent by  
2 the cylinder combustion pressure bearing against the outer surfaces of the said  
3 disc valve pushing it with greater force against the stationary stator mounted  
4 in the cylinder head. This causes the torque on the timing shaft to increase  
5 significantly as the sliding friction between the said disc valve and stator  
6 surface increase. The increase in torque of the timing shaft is partially stored  
7 in the resilient member and returned to the system when the cylinder pressure  
8 is lowered. Thus the rubbing friction between the said disc valve and said  
9 stator does not effect engine speed and acceleration to the same extent as a  
10 hard coupled system.

11 It is the primary objective of the invention to lower the compressive  
12 bearing load between the interfacing surfaces of the disc valve and stator  
13 during the combustion ignition pressure spike event and thereby reduce the  
14 shearing impact on the lubricating film within the said interface reducing the  
15 sliding friction at this point in the engine cycle.

16 It is yet another objective of the invention to lower the disc rotational  
17 friction load to quicken engine acceleration response.  
18

## 19 BRIEF DESCRIPTION OF THE DRAWINGS

20 Drawings are presented which show the engine valve timing gear and  
21 its placement in the engine power train and the method of placing a resilient  
22 member between the said engine valve timing gear and the timing shaft to  
23 provide a flexible coupling with the engine disc valve.  
24

25  
26 Fig. 1 Shows the moving components of the engine power train and shows  
27  
28

1 the point of application of the timing gear flexible couple within the kinematic  
2 circuit between the engine crankshaft and disc valve.

3  
4 Fig. 2 Is a frontal view of the disc valve timing gear showing the placement  
5 of a flexible member within the said disc valve hub as a flexible driving  
6 interface with the timing shaft.

7  
8 Fig. 3 Is a partial cross-section of the timing gear and timing shaft rotatively  
9 mounted in the supporting frame of the engine crankcase.

10  
11 Fig. 4 Is a perspective view of the resilient member comprising the flexural  
12 interface of the timing gear.

### 13 14 15 DETAILED DESCRIPTION OF THE INVENTION

16 The invention is a flexible coupling to be used in the opening and  
17 closing mechanism of a disc valve controlling the intake and exhaust flow  
18 circuits of an internal combustion engine.

19 Referring to FIG. 1 of the drawing sheet. FIG. 1 shows the moving  
20 components of the engine power train and shows the timing gear 1 and the  
21 timing gear hub 2 that holds a resilient member 3 (not shown) that is the  
22 flexural element of the timing gear 1 coupling. Timing gear 1 is rotatively  
23 mounted on timing shaft 4 which in turn is rotatively mounted in the  
24 supporting frame of an engine crankcase. Pinion bevel gear 7 is fixedly  
25 mounted at one end of timing shaft 4. Pinion bevel gear 7 engages bevel gear  
26 8 which rotates disc valve 9 in circular sliding contact with stator 10 having a  
27



1 plurality of exhaust ports 11 and intake ports 12. Rotation of disc valve 9  
2 opens and closes the said plurality of exhaust ports 11 and intake ports 12  
3 synergistically in a manner corresponding to the reciprocating translational  
4 position of piston 13 in the engine cyclic operating sequence. Piston 13,  
5 connecting rod 14 and crankshaft 15 rotating on journaled bearing surfaces 16  
6 comprise the kinematic elements of a reciprocating four-bar system providing  
7 rotational movement to crankshaft 15. Crankshaft timing gear 17 is mounted  
8 on crankshaft 15 and transmits crankshaft 15 rotational motion to timing gear  
9 1 indirectly through interconnecting driving chain 18 in the sequential manner  
10 described.

11 Those skilled-in-the-art will readily recognize the fact that pinion bevel  
12 gear 7 and bevel gear 8 can be replaced with a pinion worm gear and worm  
13 gear combination without effecting the novelty of the invention.

14 Referring now to FIG. 2. FIG. 2 is a frontal view of timing gear 1  
15 showing hub 2, resilient member 3, timing shaft 4, said timing shaft 4 having  
16 a plurality of lateral members for engaging resilient member 3, and  
17 interconnecting driving chain 18.

18 Turning now to FIG. 3 showing the inner construction of timing gear 1  
19 and its manner of rotative mounting upon timing shaft 4 and inhibiting this  
20 rotation by a resilient member placed between said timing gear 1 and timing  
21 shaft 4 coupling them together. Timing shaft 4 is rotatively mounted in needle  
22 bearing 19 held in frame 5 of the engine crankcase.

23 FIG. 4 is a perspective view of the resilient member 3. The outer  
24 surfaces of resilient member 3 in contact with timing gear hub 2 contain a  
25 plurality of outer sectors 20, in this instance four, which fit into hub 2 having  
26 similarly interfacing contours surfaces for securely holding it in said hub and  
27  
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1 recessed niches 21 for engagement with the lateral members of the timing  
2 shaft 4.  
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1  
2 CLAIMS

3 What is claimed is:

4 1. A timing gear for a disc valve engine, said timing gear having a hub  
5 aligned concentrically about its axis of rotation, said hub holding a resilient  
6 member fixedly secured by a plurality of matching interfacing sector contours  
7 configured in said resilient member and reversely contoured in said hub, said  
8 timing gear rotatively mounted on a timing shaft, said timing shaft comprising  
9 a bevel gear fixedly attached at one end and a plurality of lateral members  
10 fixedly attached at the opposite end, said lateral members passing through the  
11 center of said resilient member and in contact with a plurality of recessed  
12 niches in said resilient member.

13  
14 2. The timing gear of Claim 1 in which the said pinion bevel gear turning said  
15 bevel gear is a worm gear pinion turning a worm gear.

16  
17 3. The timing gear of Claim 1 in which the resilient member is manufactured  
18 from a natural rubber compound.

19  
20 4. The timing gear of Claim 1 in which the resilient member is compounded  
21 from a synthetic rubber.  
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1 ABSTRACT OF THE DISCLOSURE

2 The invention is a timing gear flexible coupling for operation of a disc  
3 valve rotatively mounted in an internal combustion engine cylinder head.  
4 Rotation of the disc valve periodically opens and closes a plurality of exhaust  
5 and intake ports in the stationary stator of the cylinder head in a sequential  
6 manner corresponding to the alternating order of the engine of the engine  
7 thermodynamic pressure cycle. The purpose of the flexible coupling is to  
8 momentarily slow the rotational velocity of the disc valve during the highest  
9 peak pressure of the engine combustion stroke during the ignition spike which  
10 exponentially reduces the rubbing contact frictional energy between the disc  
11 and stator. The primary purpose of the timing gear flexible coupling is to  
12 reduce the shearing impact across the lubricating film at the sliding interface  
13 between the disc valve and stationary stator comprising the engine intake and  
14 exhaust ports thereby decreasing frictional surface wear and permitting faster  
15 engine acceleration.  
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# DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

Declaration  
Submitted  
with Initial  
Filing

OR

Declaration  
Submitted after Initial  
Filing (surcharge  
(37 CFR 1.16 (e)).  
required)

Attorney Docket Number

First Named Inventor

THOMAS AGAPADES

COMPLETE IF KNOWN

Application Number

Filing Date

Art Unit

Examiner Name

As the below named inventor, I hereby declare that:

My residence, mailing address, and citizenship are as stated below next to my name.

I believe I am the original and first inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled:

TIMING GEAR FLEXIBLE COUPLING.

(Title of the invention)

the specification of which



is attached hereto

OR



was filed on (MM/DD/YYYY)

as United States Application Number or PCT International

Application Number

and was amended on (MM/DD/YYYY)

(if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent, inventor's or plant breeder's rights certificate(s), or any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached?	
				YES	NO
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

(Page 1 of 2)

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TOM AGAPIATES

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95991

Country

USA

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1-530-218-4020

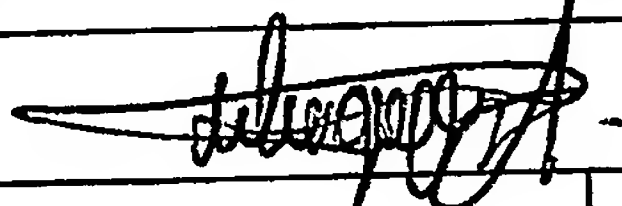
Fax

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NAME OF SOLE OR FIRST INVENTOR :

☐ A petition has been filed for this unsigned inventorGiven Name  
(first and middle [if any])

THOMAS AGAPIADES

Family Name  
or SurnameInventor's  
Signature

Date

02-19-04

Residence: City

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744 BRIDGE STREET

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State

CA

ZIP 95911

Country USA

NAME OF SECOND INVENTOR:

☐ A petition has been filed for this unsigned inventorGiven Name  
(first and middle [if any])Family Name  
or SurnameInventor's  
Signature

Date

Residence: City

State

Country

Citizenship

Mailing Address

City

State

ZIP

Country

☐ Additional inventors are being named on the \_\_\_\_\_ supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto.



Applicant or Patentee: \_\_\_\_\_ Attorney's  
 Serial or Patent No.: \_\_\_\_\_ Docket No.: \_\_\_\_\_  
 Filed or Issued: \_\_\_\_\_  
 For: \_\_\_\_\_

**VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY  
 STATUS (37 CFR 1.9 (f) and 1.27 (b)) — INDEPENDENT INVENTOR**

As a below named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR 1.9 (c) for purposes of paying reduced fees under section 41 (a) and (b) of Title 35, United States Code, to the Patent and Trademark Office with regard to the invention entitled \_\_\_\_\_ described in

☒ the specification filed herewith  
☐ application serial no. \_\_\_\_\_, filed \_\_\_\_\_  
☐ patent no. \_\_\_\_\_, issued \_\_\_\_\_

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☒ no such person, concern, or organization  
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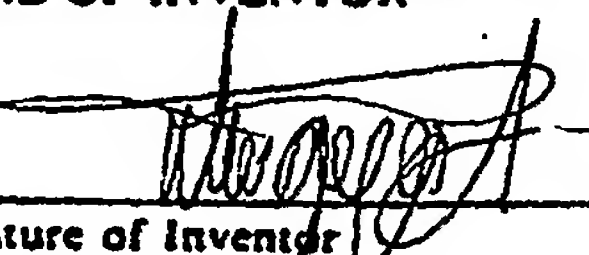
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☒ INDIVIDUAL ☐ SMALL BUSINESS CONCERN ☐ NONPROFIT ORGANIZATION

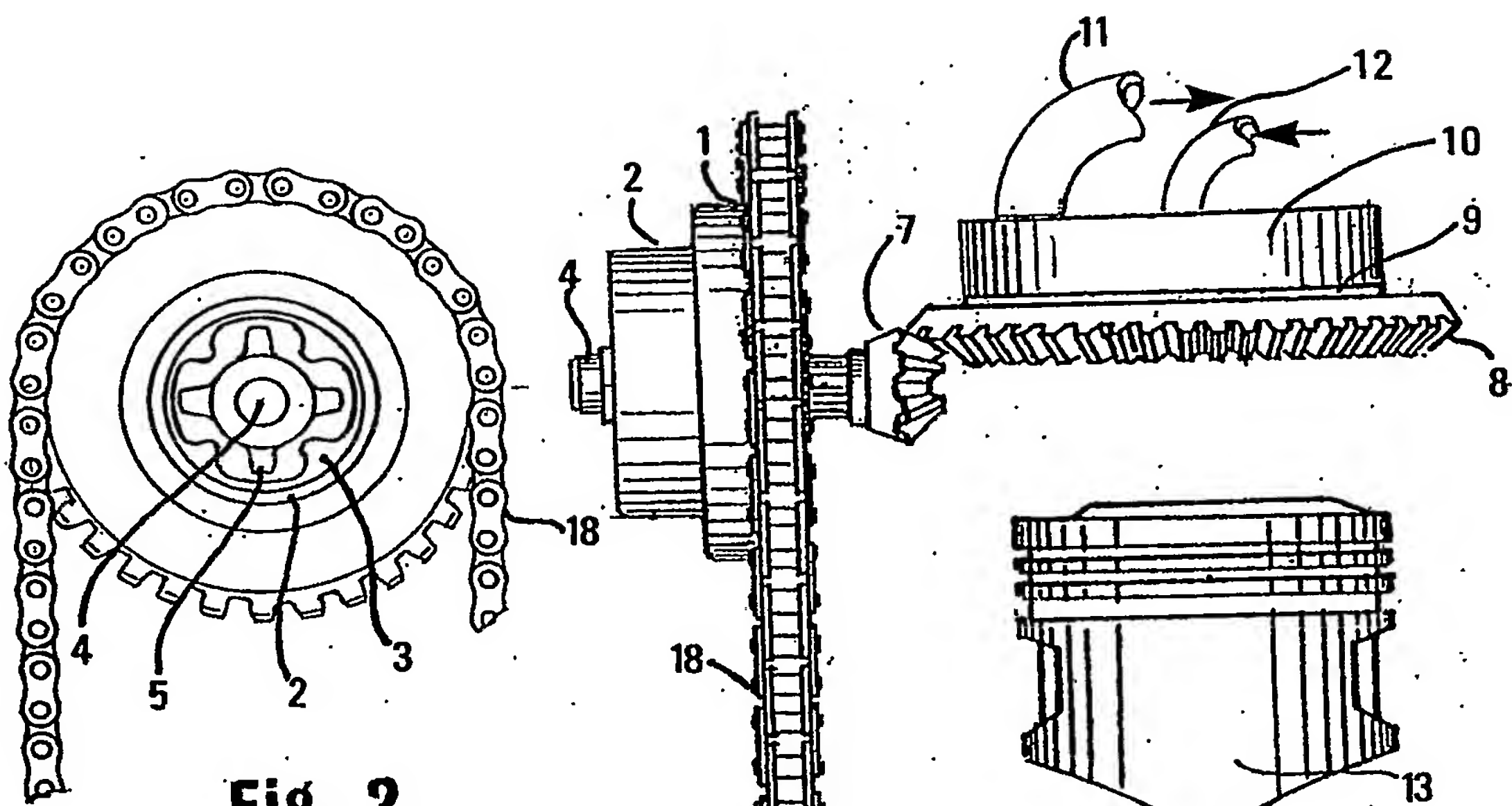
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☐ INDIVIDUAL ☐ SMALL BUSINESS CONCERN ☐ NONPROFIT ORGANIZATION

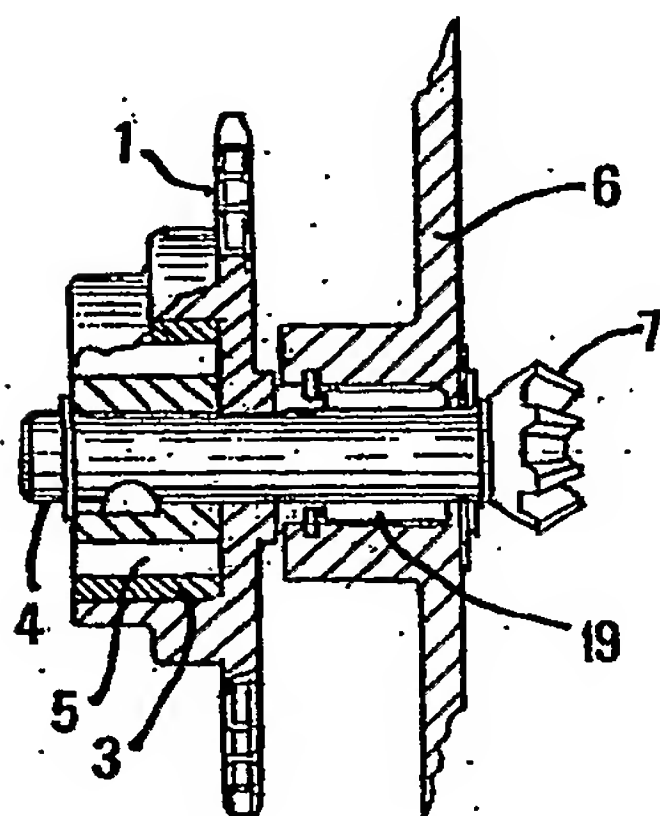
I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28 (b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

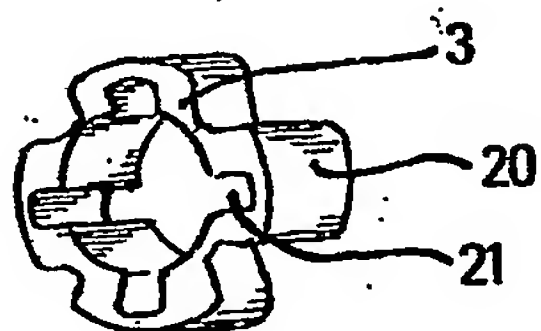
THOMAS AGAPIADES  
 NAME OF INVENTOR NAME OF INVENTOR NAME OF INVENTOR  
  
 Signature of Inventor Signature of Inventor Signature of Inventor  
02-19-04  
 Date Date Date



**Fig. 1**



**Fig. 2**



**Fig. 3**